In this centennial year of the publication of "A Dynamical Theory of the Electromagnetic Field" special interest attaches to James Clerk-Maxwell and his ideas. Jack Ramsay has found two little-known observations by Maxwell on his regard for Faraday's conceptions.

Maxwell's Greatest Tribute to Faraday

Maxwell's indebtedness to Faraday, for providing the notions upon which an Electromagnetic Theory could be based, is well known (SPECTRUM, December, 1964). A confirmatory anecdote is related by the late Sir William Bragg in a lecture he gave in 1941 at the Royal Institution in London.

"A few years ago I had occasion to consult a book in the library of the Royal Society, and as I opened it a slip of paper fell out. It was a note signed by Clerk-Maxwell saying:

'The Electromagnetic Theory of Lt (Light) as propd by him (Faraday) in Thoughts on Ray Vibrations (Phil. Mag. 1846 May) or Ex. Res. (Experimental Researches) III p 447 is the same in substance as that which I have begun to develope in this paper (A Dyne Theory of the E^e Field Phil Trans, 1865) except that in 1846 there were no data to calculate the velocity of propagation.'

"Clerk-Maxwell had already said as much as this in his printed papers, but it was of no small interest to come across this additional reference after it had lain hidden for seventy years or so." **Some slips of paper can be quite important.**

A more important development occurred after Maxwell had completed his famous Treatise on Electricity and Magnetism, published in 1873. It appears he embarked on An Elementary Treatise on Electricity. In the preface of this book Maxwell made some sensational statements. The book was published posthumously, incomplete, in 1881, and only a fragment of the preface remains. With acknowledgements to the Oxford University Press we quote a Fragment of Author's Preface:

"The aim of the following treatise is different from that of my larger treatise on electricity and magnetism. In the larger treatise the reader is supposed to be familiar with the higher mathematical methods which are *not used in this book*, and his studies are so directed as to give him the power of dealing mathematically with the various phenomena of the science. In this smaller book I have endeavoured to present, in as compact a form as I can, those phenomena which appear to throw light on the theory of electricity, and to use them, each in its place, for the development of electrical ideas in the mind of the reader.

"In the larger treatise I *sometimes made use of methods which I do not think the best in themselves*, but without which the student cannot follow the investigations of the founders of the Mathematical Theory of Electricity. *I have since become convinced of the superiority of methods akin to those of Faraday*, and have therefore adopted them from the first."

The italics are ours, to emphasize these astonishing declarations made by Maxwell. Yet they are not so astonishing, for we know that Maxwell was as much a physicist of talent as a mathematician of genius. The important deduction to be made is that Maxwell *a posteriori* decided that physical imagination is of greater value than a competence in handling symbols. In fact he actually said in his large Treatise: "I perceived that his (Faraday's) method of conceiving the phenomena was also a mathematical one, though not exhibited in the conventional form of mathematical symbols." For it is possible to think mathematically without knowing mathematics, just as it is possible to appreciate and even compose music without having had a musical training.

Maxwell died at the age of only 48 in 1879. Had he lived the tradition in electricity and magnetism, and in electronics today, could have been very different. It is our belief that the vast pile of descriptive mathematical analysis would have been replaced by a greater phenomenological richness, greater imaginative invention, and a more profound understanding of natural processes.

Let us cite the doyen of inventors, Edison. He, like Faraday and Newton, required no algebra. Let us cite Marconi, who signaled across the Atlantic despite the mathematical theorists. And today we have the challenge of the Gunn Effect solid state oscillator.

For what Maxwell pointed out is that nature is not necessarily understood by making black marks on paper or extracting rolls of paper from a calculating engine. The understanding of nature derives from the Faraday mentality where conceptual notions and experimental action jointly consummate in discovery and revelation. No accusation of naïveté will prevent man from believing his mind is superior to any of his secondary creations, whether language, mathematics or other adventitious aids.

We regret if we may seem to have been somewhat controversial latterly, but we have simply followed the implications of Maxwell's mature reflections on his work. For Maxwell was taking the view originated by Bacon that evolutionary knowledge must include induction from instances as well as deduction from premises. Our modern scientific civilization is essentially Baconian. Faraday *discovered* electromagnetism, Maxwell *deduced* that light was an electromagnetic phenomenon. Experiment and analysis must always be complementary, whence Maxwell's greatest tribute to Faraday, as chronicled above.

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